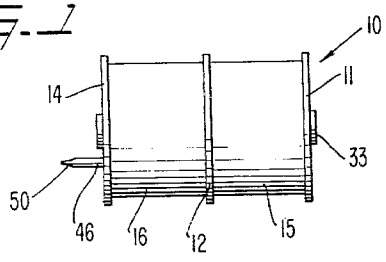
Jan. 11, 1966 I. E. LINKROUM 3,229,146

SPARK GAP DEVICE WITH A CONTROL ELECTRODE INTERMEDIATE THE MAIN ELECTRODES

Filed Oct. 2, 1961

Fig. 1



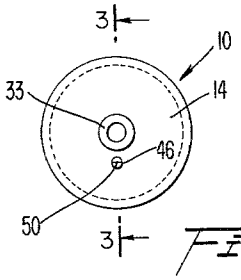


Fig. 2

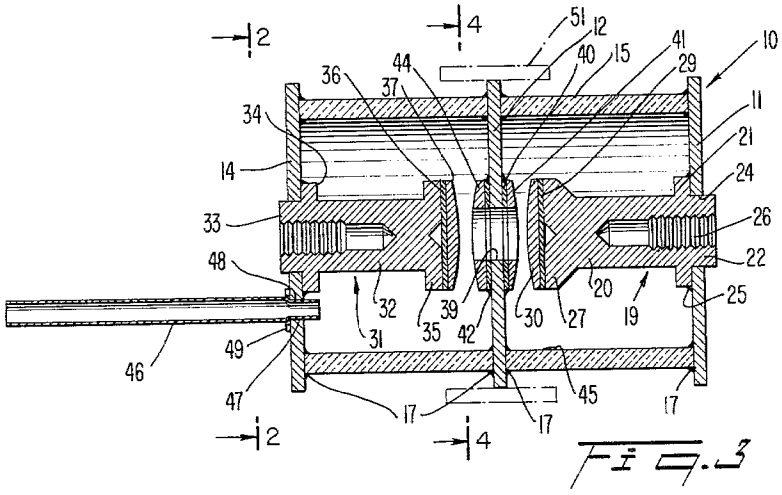


Fig. 3

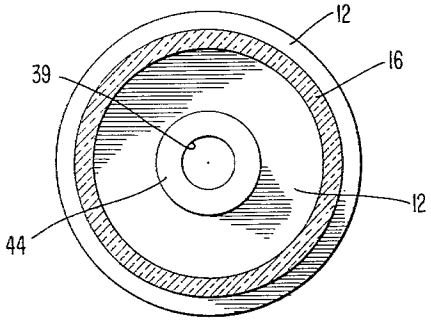


Fig. 4

INVENTOR.
IRVING E. LINKROUM

BY Bauer and Seymour

ATTORNEYS

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SPARK GAP DEVICE WITH A CONTROL ELECTRODE INTERMEDIATE THE MAIN ELECTRODES

Irving E. Linkroum, Hancock, N.Y., assignor to The Bendix Corporation, Sidney, N.Y., a corporation of Delaware

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This invention relates to a spark gap device, and more particularly relates to a spark gap device having a plurality of spark discharge gaps, one of which serves to trigger the discharge of the other gap or gaps.

The invention has among its objects the provision of a novel multi-gap spark discharge device.

Another object of the invention is the provision of a spark discharge device of the type indicated, wherein the spark gaps are enclosed within a gas filled envelope.

Yet another object of the invention lies in the provision of a novel multiple spark gap device, wherein the breakdown voltages of the respective gaps may be readily set to fall within predetermined voltage ranges during the manufacture of the device.

A further object of the invention lies in the provision of a sealed multiple spark gap device which is simple, rugged, and economical to manufacture.

The above and further objects and novel features of the invention will more fully appear from the following description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only, and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views.

FIG. 1 is a view in side elevation of an illustrative embodiment of spark gap device in accordance with the invention;

FIG. 2 is a view in end elevation of the spark gap device, the view being taken in the direction from left to right in FIG. 1;

FIG. 3 is a view in vertical axial section through the spark gap device, the section being taken along the line 3—3 of FIG 2; and

FIG. 4 is a view in transverse section through the spark gap device, the section being taken along the line 4—4 of FIG. 3.

The spark gap of the invention is useful, for example, in circuits wherein the discharge of stored energy in one portion of a circuit initiates or triggers the discharge of stored energy from another part of the circuit. The embodiment of spark gap device of the present invention is useful, for example, as the three electrode spark gap device generally designated 97 in the application of Louis H. Segall and Paul A. Blackington, Serial No. 143,796, filed October 9, 1961, now Patent No. 3,146,376. It is to be understood, however, that such use of the spark gap device of the present invention is illustrative only, since such device obviously is capable of use to advantage in a number of other circuits.

Turning now to the drawings, the spark gap device shown is generally designated by the reference character 10. Such device has a gas impervious envelope formed of disc-like end closure members 11 and 14, two aligned insulating tubes 15 and 16 which in this instance are made of glass, and an intermediate disc-like member 12 disposed coaxially of members 11, 14, 15, and 16 and sealed adjacent its outer edge to the axially inner ends of tubes 15 and 16. Members 11, 12, and 4 may be made, for example, of an alloy sold under the trademark "Kovar," and glass tubes 15 and 16 may be made of a glass known

as Corning glass No. 7052. The ends of tubes 15 and 16 are sealed to the respective members 11, 12, and 14 by being fused and bonded thereto at the annular zones designated 17.

The thus described envelope carries mounted therewithin three axially aligned electrodes, the outer electrodes being generally designated 19 and 31, respectively, and the intermediate electrode, mounted on element 12, including elements 41 and 44 which confront and are spaced from electrodes 19 and 31, respectively. As is apparent in FIG. 3, the gap forming portions 30 and 41 are spaced from each other a distance which is somewhat smaller than that between gap forming portions 37 and 44.

The electrode 19 has a stem-like electrode support 20 which extends axially inwardly from end closure member 11. Member 20 has an outwardly directed flange 21 adjacent its outer end, and a short exially extended portion 22 outwardly of such flange. A central hole 24 is provided in member 11, such hole snugly receiving the outer portion 22 of the stem 20. Member 20 is retained upon and sealed to member 11 by staking member 11 its outer surface about portion 22 of the stem, and by an annular weld 25 between flange 21 and the inner face of member 11. Member 20 has an axial bore extending thereinto from its outer end, such bore being threaded at 26 to receive a terminal-securing screw (not shown). The inner end of member 20 is enlarged to form a head 27. A disc 30 of metal such as tungsten is brazed to the end of head 27 through the medium of an interposed disc 29 of copper or the like.

Electrode 31 is substantially similar to electrode 19. Electrode 31 has a stem-like member 32 which extends axially of the envelope, member 32 having a flange 34 and an axially outwardly extending portion 33. Electrode 31 is secured to end closure member 14 in the same manner as electrode 19 is secured to member 11. Electrode 31 has a disc-like member 37 made of tungsten or the like brazed to head 35 of the electrode by an interposed copper disc 36.

Member 12, which supports the intermediate electrode, has a central axial opening 39 therethrough of a diameter somewhat less than the diameter of gap forming members 30 and 37. Mounted on the right-hand face of element 12 coaxial thereof is a first annular electrode part 41, made of metal such as tungsten, part 41 being brazed to element 12 by a washer-like copper member 40. A second annular member 44, made of tungsten or the like, is brazed to the left-hand face of element 12 by means of an annular copper piece 42. Parts 40, 41, 42 and 44 have holes therethrough equaling the diameter of hole 39, so that the intermediate electrode assembly presents a free path therethrough for travel of gaseous ions from one gap to the other. During the manufacture of the device 10, the space between members 30 and 41, forming the first gap, and that between members 37 and 44, forming the second gap, are determined so that they fall within a very close predetermined range.

End closure member 14 is provided a small hole 48 therethrough to which is sealed a metal tube 46. Such tube is necked in at 47, the necked-in portion is telescoped into the hole, and the tube is brazed thereto at an annular zone 49. A small amount of radioactive material is deposited on the inner surface of glass tube 15 as indicated at 45, in a location adjacent to the gap between members 30 and 41. The radiations from radioactive material 45 provide a basic value of ionization of the gas within the envelope and particularly between the electrodes forming the first spark gap, thereby facilitating the breakdown of such gap upon the imposition of a predetermined desired voltage thereto.

After the device 10 has been completed to the state shown in FIG. 3, the envelope is first evacuated through

tube **46**, following which the envelope is filled with a mixture of gas made up of 80% by weight hydrogen and 20% by weight argon. The electrodes forming the first gap **30**, **41** are connected to a test circuit, connected to the electrode **41** being affected by a clamp-like device **51** encircling the device **10** and engaging the outer rim of member **12**. The presure of the mixture of gases within the envelope is adjusted so that the gap **30**, **41** breaks down at a desired predetermined voltage. Since the other gap, between members **37** and **44**, has been accurately gauged, it is not necessary to determine the breakdown voltage of the second gap by test. When the spark gap device of the present invention in the embodiment shown is employed in the circuit disclosed in the above-referred-to Segall and Blackington application, the spacings between the electrodes, and the pressure of gas employed in the envelope are such that the gap **30**, **41** breaks down at 3,000 volts, and the gap **37**, **44** breaks down in the range between 3,700 and 4,500 volts.

Although only one embodiment of the invention has been illustrated in the accompanying drawings and described in the foregoing specification, it is to be especially understood that various changes, such as in the relative dimensions of the parts, materials used, and the like, as well as the suggested manner of use of the apparatus of the invention, may be made therein without departing from the spirit and scope of the invention, as will now be apparent to those skilled in the art.

What is claimed is:

1. In a spark gap device, two axially aligned insulating tubes, a metallic center plate interposed between and sealed to adjacent ends of said tubes, two metallic end plates extending across and sealed to the remote ends of said tubes, each of said plates having a central passage therein, end electrodes supported by and extending inwardly toward each other from said end plates, said electrodes comprising stem portions filling the passages

in and sealed to said end plates, and electrode means on said center plate comprising rings secured to opposite faces of said center plate concentric with the passage therethrough and in spark gap relation with the inner ends of said end electrodes.

2. A spark gap device as defined in claim **1**, wherein said end electrodes comprise head portions having convex sphere-like end surfaces at the inner ends thereof.

3. A spark gap device as defined in claim **1**, wherein the outer surface of said rings are convex sphere-like.

4. A spark gap device as defined in claim **1**, wherein the shortest distance between each said electrode ring and the end electrode adjacent thereto is at the inner periphery of the ring.

5. A spark gap device as defined in claim **1**, wherein opposed surfaces of each of said rings and of the end electrodes adjacent thereto are divergent outwardly from the inner periphery of the ring.

6. A spark gap device as defined in claim **1**, wherein each end electrode comprises a head portion comprising a disc of erosion-resistant metal secured to the end of said stem portion.

References Cited by the Examiner

UNITED STATES PATENTS

2,123,333	7/1938	Hansell	313—240
2,478,119	8/1949	Mitchel	313—54 X
2,817,036	12/1957	Neal	313—193 X

FOREIGN PATENTS

1,089,482	9/1960	Germany.

ROBERT SEGAL, *Acting Primary Examiner.*

BENNETT G. MILLER, GEORGE N. WESTBY, *Examiners.*